

## Overview

The LA5601 is a voltage regulator with a low-voltage detector and reset controller for use in microprocessor-based systems. It generates a reset signal for low power supply voltage. It also features a low 0.25V (typ.) dropout voltage for reduced power dissipation and power supply size. Applications include microprocessor-controlled consumer electronic equipment such as CD players, tuners and receivers, and preamplifiers.

## Functions

- Low dropout regulator with 250mA and 5.2V output
- Power supply reset generator function
- Supports on-off control of 5.2V using equipped enable pin (high active)
- Built-in Darlington driver (120mA)
- Built-in auxiliary regulator (5.2V, 250mA)

## Features

- Low minimum input-output voltage difference (0.3V typ.)
- Supports setting of reset output delay time using external capacitor
- Built-in fold-back current limiting circuit and excessive heat protection circuit.
- Reset output using active pull-up for simpler noise reduction and use with internal pull-down logic circuits
- Error amplifier noise filter pin
- Auxiliary regulator with reverse current protection

## Specifications

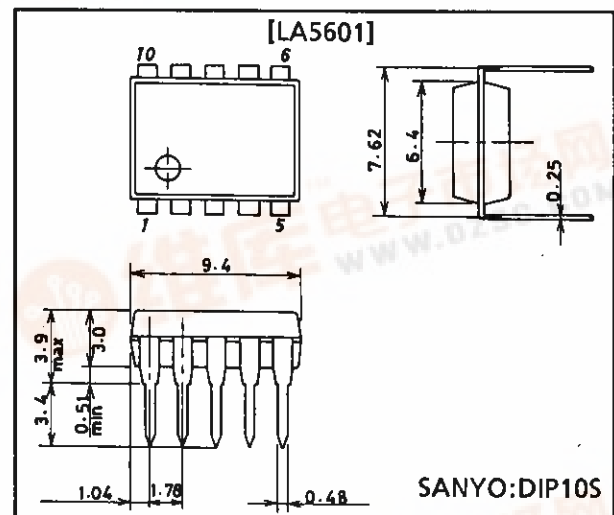
Maximum Ratings at  $T_a = 25^\circ\text{C}$

			unit
Input Voltage	$V_{IN}$ max	15	V
Enable Pin Voltage	$V_{EN}$ max	$V_{IN}$ max	V
Reset Output Pin Voltage	$V_{RES}$ max	15	V
Driver Output Voltage	$V_{OD}$ max	15	V
Driver Input Voltage	$V_{ID}$ max	15	V
Allowable Power Dissipation	$P_d$ max	1	W
Operating Temperature	$T_{opr}$	-30 to +80	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-55 to +150	$^\circ\text{C}$

## Package Dimensions

unit:mm

3098-DIP10S



LA5601

Operating Conditions at Ta = 25°C

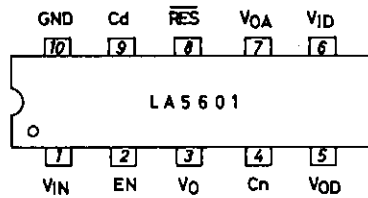
			unit
Input Voltage	V <sub>IN</sub>	5.9 to 14	V
Output Current	I <sub>OUT</sub>	0 to 250	mA
'H'-Level Reset Output Current	I <sub>ORH</sub>	0 to 200	μA
'L'-Level Reset Output Current	I <sub>ORL</sub>	0 to 2	mA
Auxiliary Regulator Output Current	I <sub>OA</sub>	0 to 10	mA
Driver Output Voltage	V <sub>OD max</sub>	14	V
'L'-Level Driver Output Current	I <sub>ODL max</sub>	120	mA
'H'-Level Driver Input Voltage	V <sub>IDH</sub>	I <sub>ODL</sub> = 120mA	3 to 14 V
'L'-Level Driver Input Voltage	V <sub>IDL</sub>	I <sub>ODL</sub> ≤ 100μA	-0.3 to +0.3 V

Operating Characteristics at Tj = 25°C, V<sub>IN</sub> = 6V, I<sub>OUT</sub> = 200mA, See specified Test Circuit.

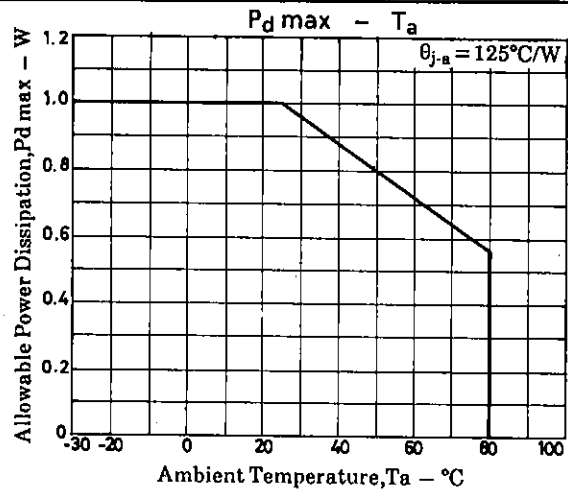
[Main regulator : Output ON-state, V <sub>EN</sub> = 'H' or open]				min	typ	max	unit
Output Voltage	V <sub>O</sub>			5.0	5.2	5.4	V
Dropout Voltage	V <sub>DROP</sub>	I <sub>OUT</sub> = 250mA		0.25	0.5		V
Line Regulation	ΔV <sub>OLN1</sub>	5.5V ≤ V <sub>IN</sub> ≤ 14V		30	80		mV
	ΔV <sub>OLN2</sub>	6V ≤ V <sub>IN</sub> ≤ 14V		20	40		mV
Load Regulation	ΔV <sub>OLD1</sub>	5mA ≤ I <sub>OUT</sub> ≤ 250mA		40	100		mV
	ΔV <sub>OLD2</sub>	5mA ≤ I <sub>OUT</sub> ≤ 100mA		14	50		mV
Peak Output Current	I <sub>OP</sub>			250	500		mA
Output Short Current	I <sub>OSC</sub>				80	300	mA
Current Drain	I <sub>Q1</sub>	I <sub>OUT</sub> = 0		2.2	6		mA
	I <sub>Q2</sub>			10	30		mA
Output Noise Voltage	V <sub>NO</sub>	10Hz ≤ f ≤ 100kHz		70			μV <sub>rms</sub>
Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT <sub>j</sub>	T <sub>j</sub> = 25 to 80°C		-0.7			mV/°C
Ripple Rejection	R <sub>rej</sub>	f = 120Hz, 7V ≤ V <sub>IN</sub> ≤ 13V			74		dB
Output ON-State Control Voltage	V <sub>ENH</sub>	Main regulator, driver ON		2.6		V <sub>IN</sub>	V
[Main regulator : Output OFF-state, V <sub>EN</sub> = 'L']							
'L'-Level Output Voltage	V <sub>O OFF</sub>	V <sub>EN</sub> = 0		50	200		mV
Quiescent Current	I <sub>Q OFF</sub>	V <sub>EN</sub> = 0		1.5	4		mA
Output OFF-State Control Voltage	V <sub>ENL</sub>	Main regulator, driver OFF			1.0		V
[Reset circuit]							
'H'-Level Reset Output Voltage	V <sub>ORH</sub>	I <sub>ORH</sub> = 200μA		4.97	5.17	5.37	V
'L'-Level Reset Output Voltage	V <sub>ORL</sub>	I <sub>ORL</sub> = 2mA, V <sub>IN</sub> = 3.7V			90	200	mV
Reset Threshold Voltage	V <sub>RT</sub>	I <sub>OUT</sub> = 5mA		3.7	3.9	4.1	V
Reset Hysteresis Voltage	V <sub>hys</sub>	I <sub>OUT</sub> = 5mA		50	150	300	mV
Reset Output Delay Time	t <sub>d</sub>	C <sub>d</sub> = 0.1μF		7.5	10	12.5	mS
[Auxiliary regulator]							
Output Voltage	V <sub>OA</sub>	I <sub>OA</sub> = 5mA		3.2	3.4	3.6	V
Line Regulation	ΔV <sub>OA LN</sub>	6V ≤ V <sub>IN</sub> ≤ 14V, I <sub>OA</sub> = 5mA			15	40	mV
Load Regulation	ΔV <sub>OA LD</sub>	2mA ≤ I <sub>OA</sub> ≤ 10mA			130	200	mV
Output Short Current	I <sub>OASC</sub>			10	30		mA
Output Pin Leakage Current	I <sub>OA LEAK</sub>	V <sub>IN</sub> = 0, V <sub>OA</sub> = 6V				2	μA
[Darlington driver]							
'L'-Level Driver Output Voltage	V <sub>ODL1</sub>	I <sub>ODL</sub> = 80mA, V <sub>ID</sub> = 3V		1.1	1.6		V
	V <sub>ODL2</sub>	I <sub>ODL</sub> = 120mA, V <sub>ID</sub> = 3V		1.2	1.8		V
'H'-Level Driver Input Current	I <sub>IDH</sub>	I <sub>ODL</sub> = 120mA, V <sub>ID</sub> = 3V		0.4	1		mA
Output Pin Leakage Current	I <sub>ODH</sub>	V <sub>IH</sub> = 14V, V <sub>OD</sub> = 14V, V <sub>ID</sub> = 0.3V				50	μA

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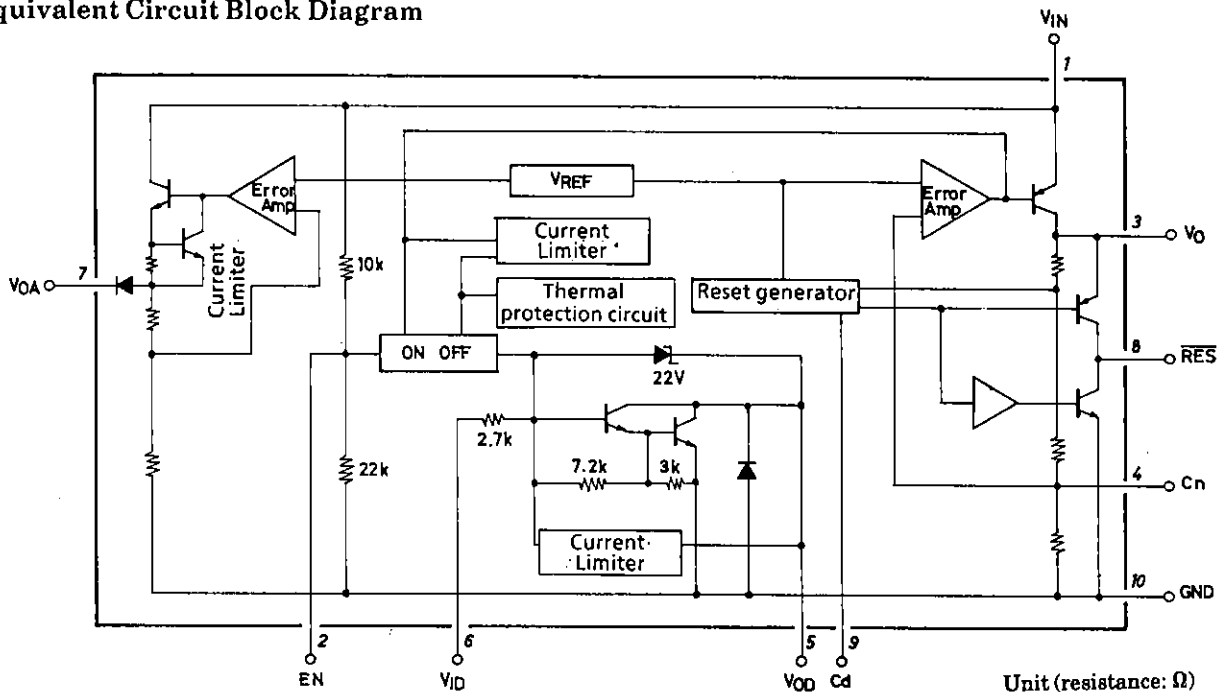
## Pin Assignment



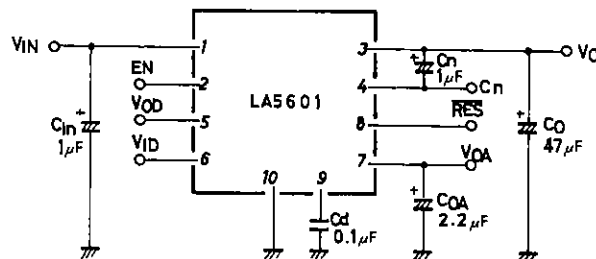
Top view



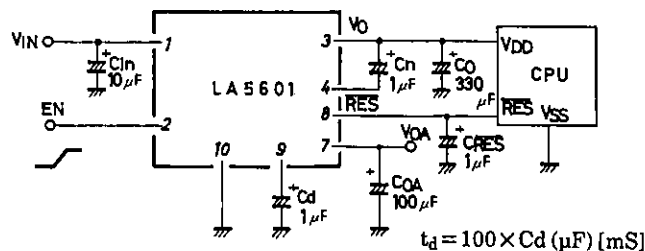
## Equivalent Circuit Block Diagram



## Specified Test Circuit



## Sample Application Circuit 1



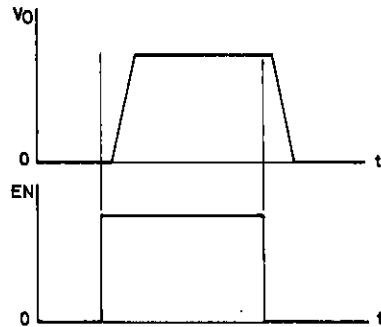
- Note) 1. Capacitors  $C_n$  and  $C_{RES}$  are only required if problems are experienced with noise from external sources.
2. If capacitor  $C_n$  is present, ensure that  $C_o$  is at least more than one-third of the value of  $C_{in}$  in order to prevent output noise at power-down due to capacitor discharge timing.
3. The minimum recommended value of output capacitor  $C_o$  is 47µF.
4. Use a low temperature coefficient capacitor for the delay time capacitor  $C_d$ .

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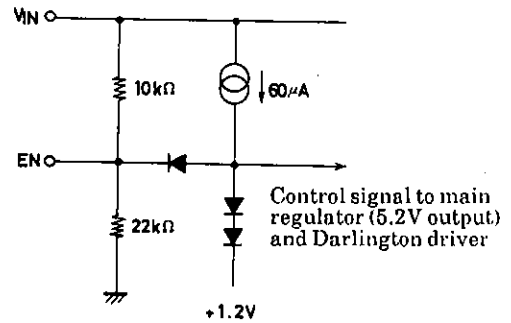
## Function Table

V <sub>EN</sub>	V <sub>O</sub>	Driver
L	L	OFF
H	H	ON

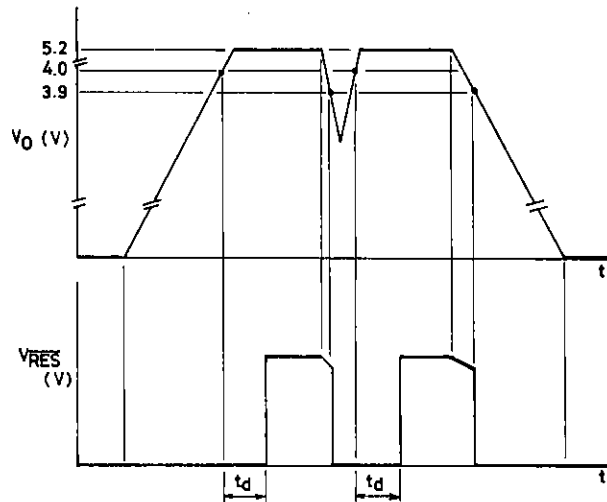
V<sub>EN</sub> = 'H' or open.



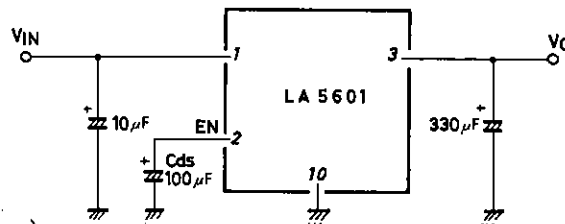
## Enable Circuit



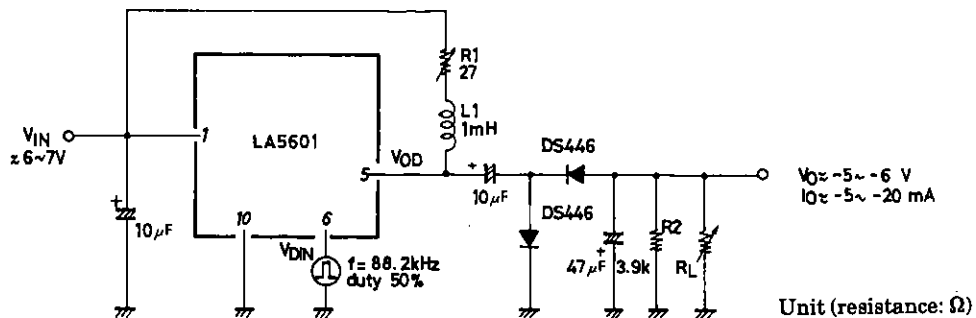
## Reset Operation



## Sample Application Circuit 2 (Delay start regulator)

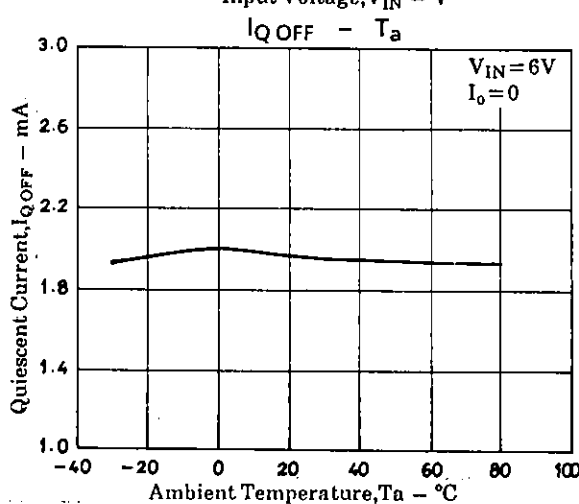
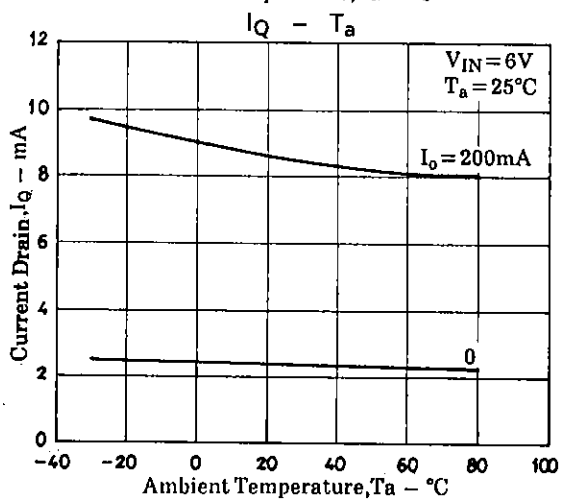
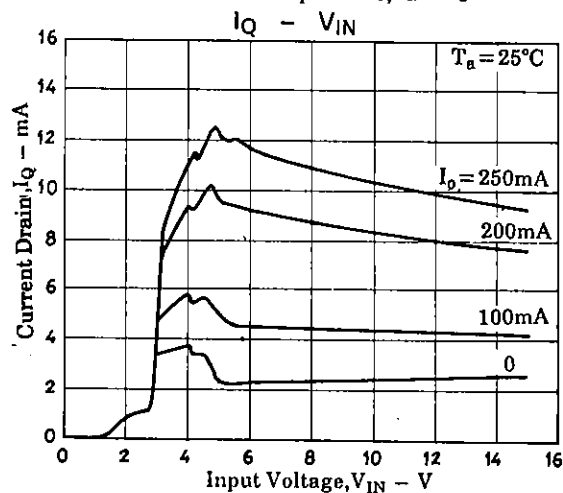
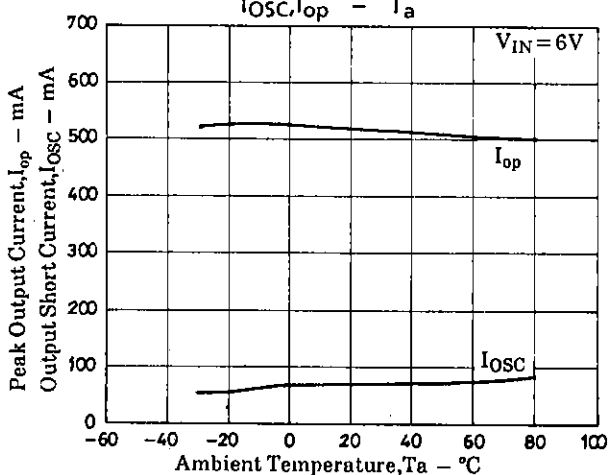
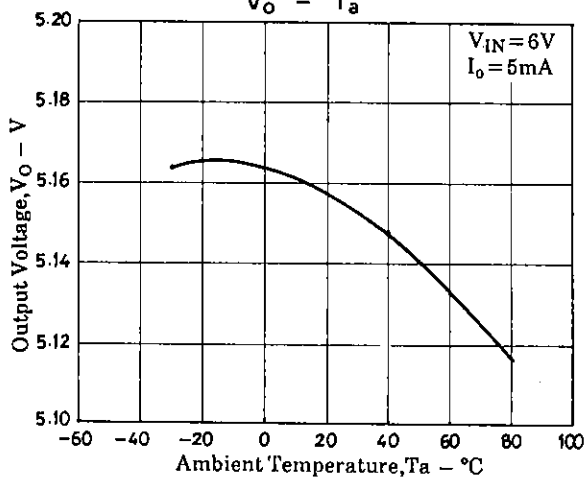
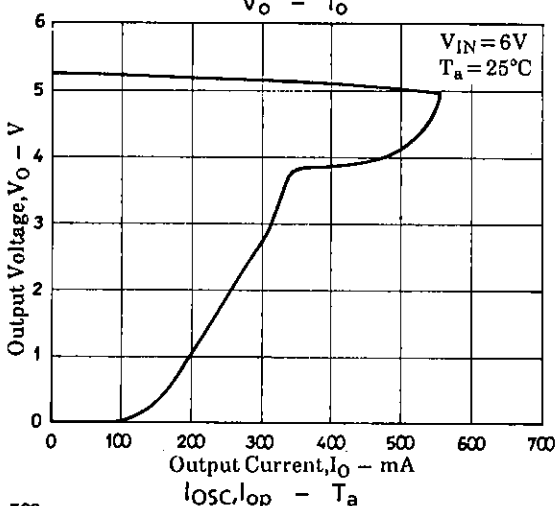
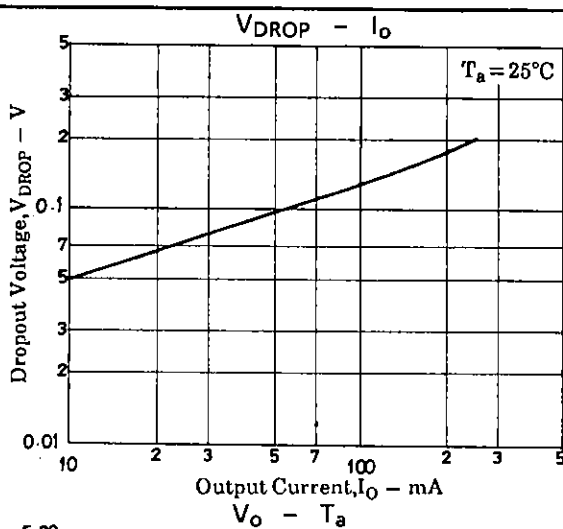
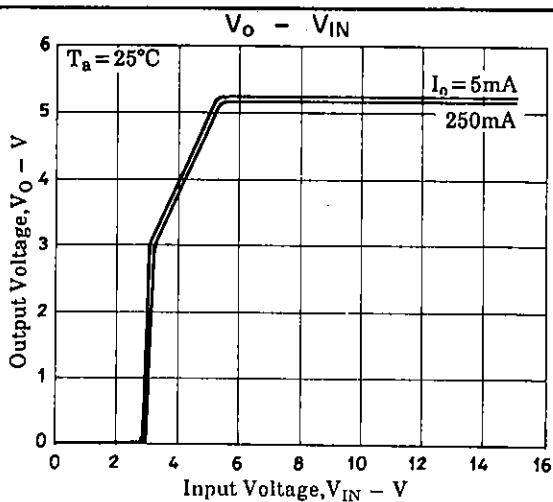


## Sample Application Circuit 3 (Positive-to-negative DC converter)

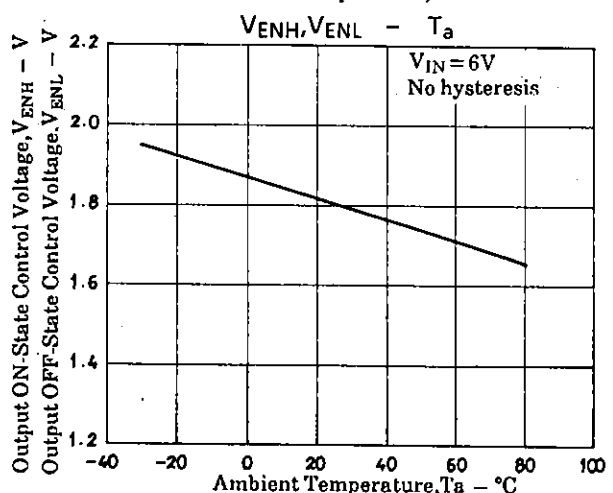
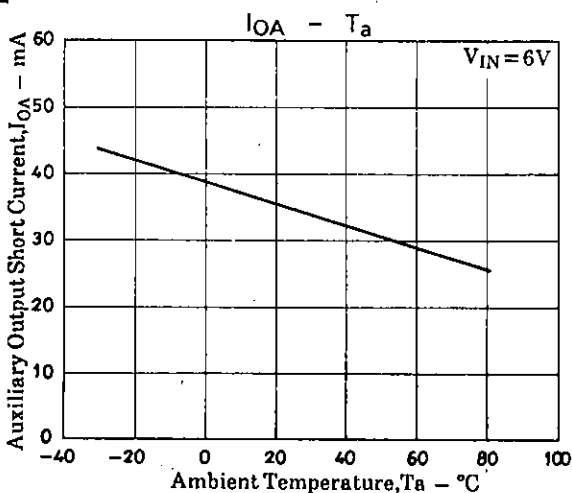
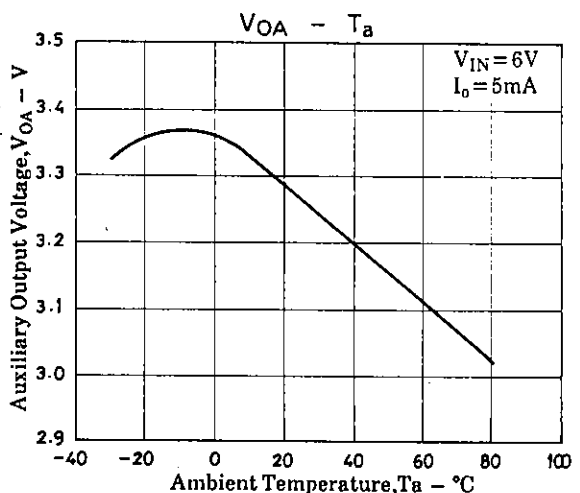
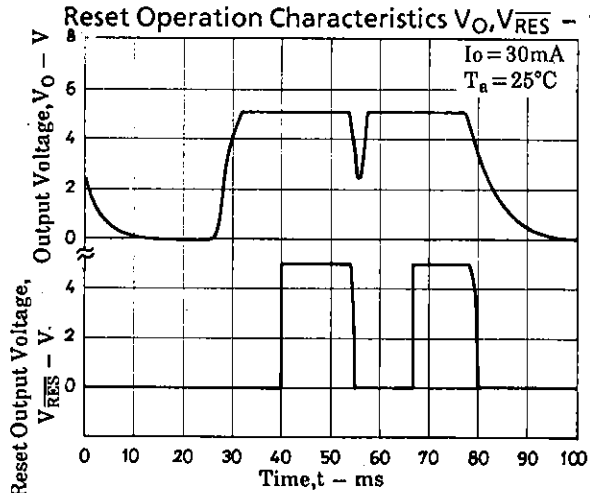
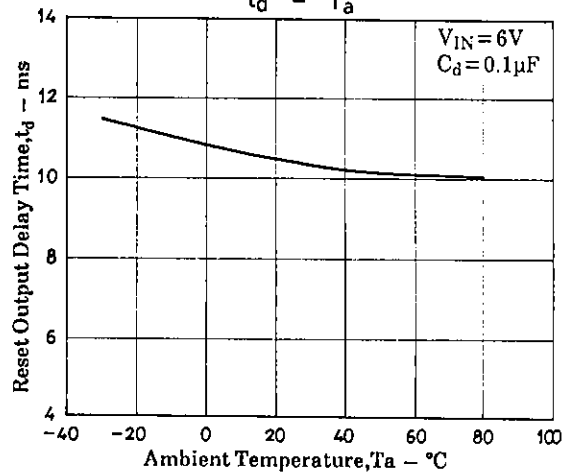
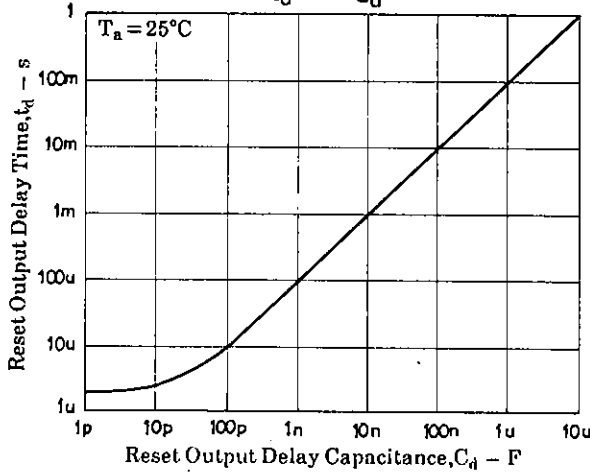
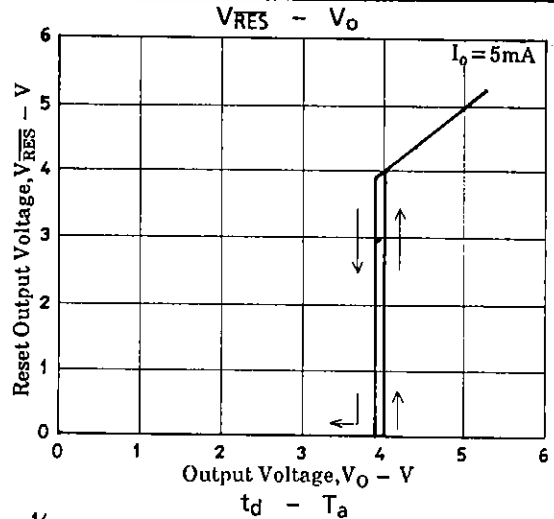
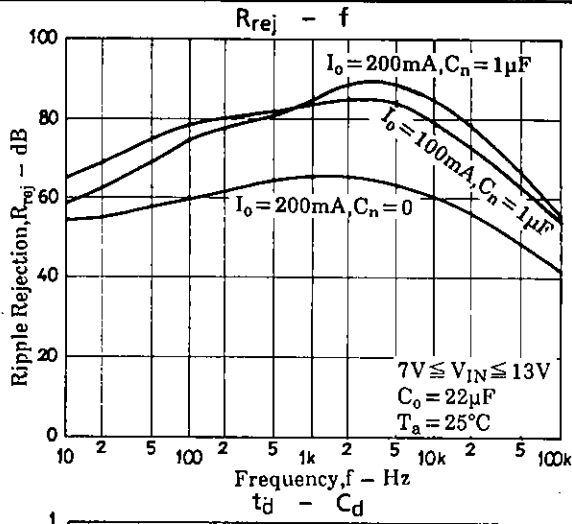


- Note) 1. The output voltage can be fine-trimmed by adjusting R1. To protect the output transistor against over voltage, ensure that either R1 is non zero or use a low-Q coil for L1.
2. A load must always be present on power-up. To safeguard against excessive output voltages that occur when the circuit is powered up without a load, a dummy load resistor is recommended. This is shown on the circuit as R2.
3. Select V<sub>IN</sub>, R1 and L1 so that V<sub>OD</sub> < 14V, and I<sub>ODL</sub> < 120mA. The component values shown require that V<sub>IN</sub> never exceeds 9V.

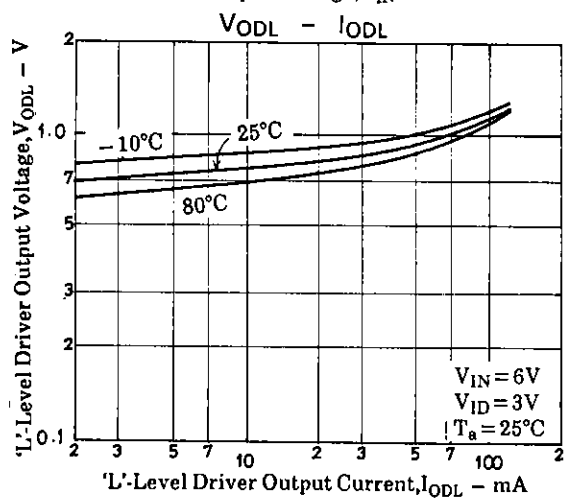
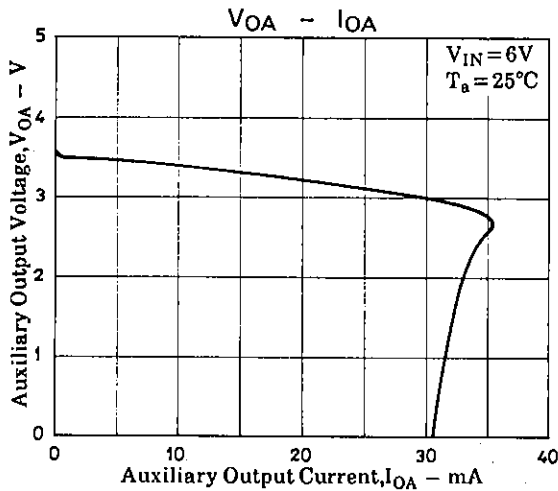
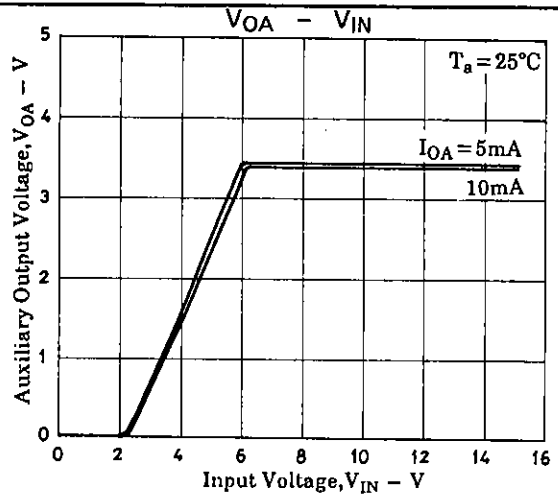
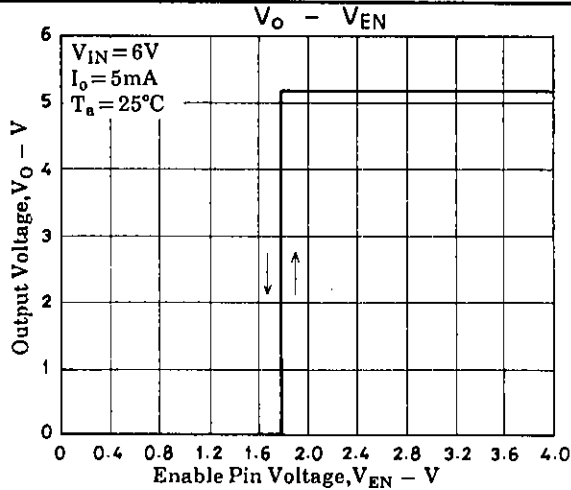
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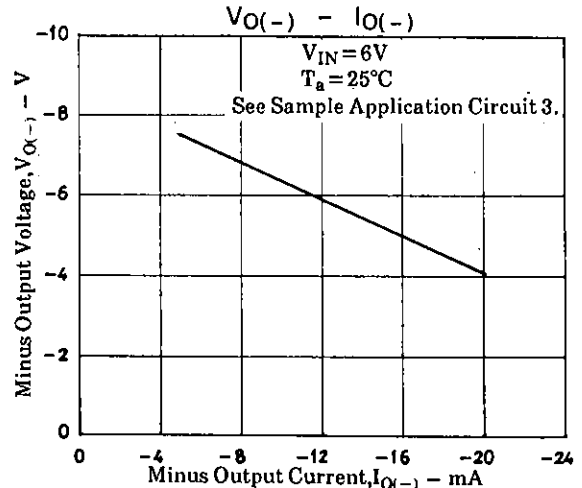
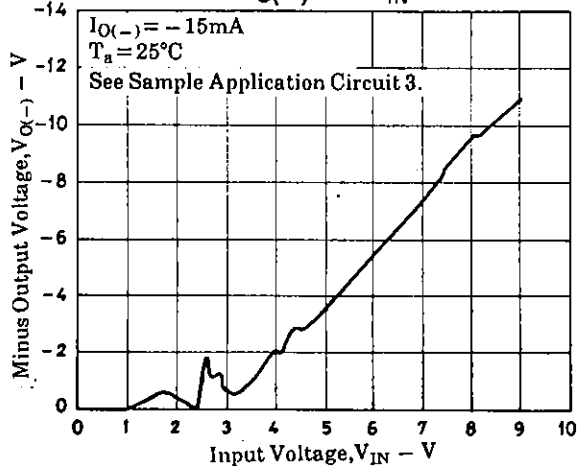
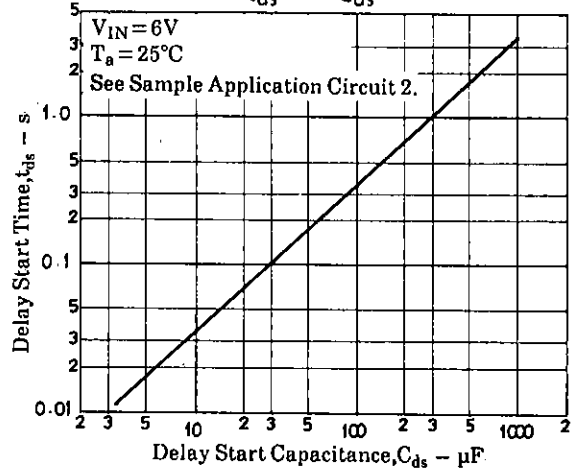
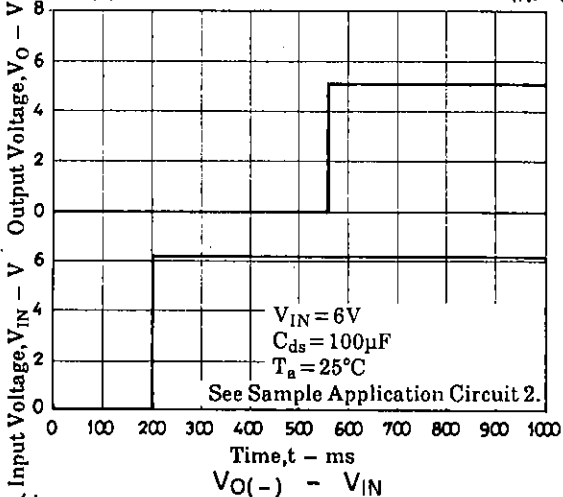
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Delay Start Application Circuit Characteristics  $V_{IN}, V_O - t$



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